



NEUROEDUCATION: LEARNING, ARTS, AND THE BRAIN

Findings and Challenges for Educators and Researchers
from the 2009 Johns Hopkins University Summit



Executive Summary

On May 6, 2009, the Neuro-Education Initiative of The Johns Hopkins University School of Education, with support from The Dana Foundation, hosted its inaugural national Learning, Arts, and the Brain Summit to explore the intersection of cognitive neuroscience, the arts, and learning. More than 300 educators, scientists, school administrators, and policy makers shared their perspectives on advancing the science of learning through the lens of arts training and its effects on cognition.

The emerging field of neuroeducation explores how children learn and what practices promote and sustain the learning process. Neuroeducation is an interdisciplinary field that combines neuroscience, psychology, and education to help create improved teaching methods and curricula.

Summit presentations expanded on the results of studies included in the Dana Arts and Cognition Consortium report, released in March 2008. The report, based on multiple three-year studies from seven universities, examined whether early arts training can cause changes in the brain that enhance other aspects of cognition. Consortium researchers found “tight correlations” between arts training and improvements in cognition, attention, and learning.

Through this summit, the research and education communities came together to discuss what neuroscience research has demonstrated to date concerning the effects of arts training on cognition and to explore future research priorities and opportunities. The summit’s purpose was not to debate whether children need the arts, but rather to explore how studying and practicing the arts might enhance creativity, cognition, and learning.

Three questions guided the proceedings: (1) What do we know from cognitive-neuroscience research concerning the effects of arts training on the brain that could and should be accessible to teachers? (2) What new research is relevant and possibly related to how studying an art form helps students learn better? and (3) How does the process of learning with and through the arts improve academic performance?

Summit Structure

Hosted at the American Visionary Art Museum in Baltimore, the summit provided a full day of proceedings that began with introductory remarks by the summit hosts and university officials.

As articulated by summit hosts Mariale Hardiman, Ed.D., and Susan Magsamen, both of The Johns Hopkins University School of Education, the agenda for the Learning, Arts, and the Brain Summit was organized around a premise and an invitation:

The premise

The empirical classroom experience of arts integration subjectively suggests that carefully structured arts-based pedagogy can improve students' learning and academic experiences, resulting in demonstrably positive outcomes that include deeper engagement in subject matter and better retention of content; greater emotional involvement in the learning process and deeper social awareness; and the ability to apply principles across disciplines.

Arts integration is also important from a national, macroeconomic perspective: graduates are entering the workforce without critical skills that arts-based learning is known to promote—collaboration, creative problem-solving, and the ability to apply learning across different disciplines. Further, exposure to the arts as a participant or observer has the potential to have profound effects on learning and memory, context, and comprehensive creative thinking.

The invitation

Unite the domains of education and neuroscience to identify and design classroom strategies that research suggests may promote the desired outcomes; test whether outcomes improved; and refine the strategies accordingly. What are the mechanisms at work between arts-based learning and improved cognition?

From Classroom to Lab, and Lab to Classroom

To open the day-long program, neuroscientists Guy McKhann, M.D., The Johns Hopkins University,

and Kenneth Kosik, M.D., University of California, Santa Barbara, provided insights into the emerging field of neuroeducation. Ellen Galinsky, president of the Family and Work Institute, made opening remarks and introduced a short video from Michael Gazzaniga, Ph.D., University of California, Santa Barbara. Dr. Gazzaniga provided an overview and summary of the findings from the Dana consortium report (see chapter three).

McKhann called for research that tracks one test group over time. When one introduces arts-integrated methodologies into the classroom and observes the resulting learning, he asked, which outcomes are attributable to the new methodologies and which might be ascribed to the intrinsic capabilities of the participating students?

Kosik, a founder of the Learning and the Brain Conference, now in its 12th year, reported some of the lessons learned about marrying the domains of neuroscience and education: “Educators are seriously interested in research; they are hungry for information. Neuroscientists are typically less interested in education; they haven’t gotten into the trenches with educators. Conference participants want to know what they can do when they get back to their classrooms.” He noted that the scientific community now is beginning to have answers, and is prepared to begin addressing teachers’ needs and questions.

Galinsky commented on her research into what happens when students are not engaged and not learning the skills they need. Her studies began with “not learning,” that is, when students reported that they were just learning “stuff” to get a job, go to college, and do better in life. In contrast, when students said they were truly learning, they described the experience as “feeling bigger than usual, finding a sense of purpose, and knowing who they were.”

Galinsky also noted that the Dana Foundation research suggests arts training can be a jump-starter for students. For example, students who have

theater training in high school often score higher in social aptitude. How then does the larger community make this belief in the arts more credible in teachers' minds? If educators see a substantive body of work affirming the benefits of arts training, they'll be more likely to include and integrate the arts into schools and classrooms, she said.

Scientific presentations were then offered by a panel of researchers. The panel, moderated by William Safire, chairman of the Dana Foundation, was asked to present recent findings on the influence of the arts on learning and to provide direction for future research. The presenters were: Michael Posner, Ph.D., University of Oregon; Elizabeth Spelke, Ph.D., Harvard University; Brian Wandell, Ph.D., Stanford University; Ellen Winner, Ph.D., Boston University; and Gottfried Schlaug, M.D., Ph.D., Harvard University (see section three for edited excerpts of the panel discussion).

There were significant findings to report. Winner and Schlaug discussed recent results from the first 15 months of a four-year study of children who received regular music instruction compared to those who did not. The controlled study was designed to determine whether music training affected near-transfer domains—those skills closely related to the training, such as fine motor control. They also tested for far transfer, that is, transfer to learning in other domains. Analysis of data based on 15 months of training showed that students who were given music instruction performed better in near-transfer domains. Equally important, imaging showed that changes occurred in certain brain structures compared to the non-trained students. This is the first study to show brain plasticity in young children as a function of musical instruction. At this 15-month period, they found no differences between the music and non-music groups in far transfer; the final determination awaits analysis of data from the full four years of the study.

Posner presented research that focuses on the executive attention network, which is involved



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Art from a third grade student at Roland Park Elementary/Middle School, Baltimore

in self-control. He explained that each art form engages a neural network. In children who are open to, interested in, and motivated to practice a specific art form, training focuses their attention and strengthens the executive attention network.

Posner found that controlled training on attention-related tasks in young children increased the efficiency of the executive attention network and also improved other learning domains. When children were given training specifically designed to improve attention, not only did attention improve, but the generalized parts of intelligence related to fluid intelligence increased as well. "Years of neuroimaging have now given us a plausible mechanism by which arts training could now influence cognition and IQ," he said. Posner is also studying candidate genes that may explain

individual differences in interest in the arts, and he is researching the interactions between genes and environment involved in strengthening the efficiencies of attention networks.

Spelke, whose earlier research showed a strong correlation between intense music practice and geometrical representation skills, described her latest research with infants, which explores the possible brain basis of this correlation. She was able to create sounds in different timbres, which were paired with objects of different heights. In some trials, a baby would hear a rising sequence of notes, in others, a falling sequence. But, in both cases the height of the object related to the pitch of the note. (When the notes fell so did the object.) With a second set of infants, the same sounds and objects were shown, but the pairing was reversed. The results showed that the infants learned the pairing of tone and object height when it was congruent, but not when it was incongruent. Spelke said that as early as four months, babies seem to be “sensitive to relationships between the two key properties of a melody and positions in space.”

Wandell spoke of his research demonstrating that music training is tightly correlated with

phonological awareness—the ability to differentiate and manipulate speech sounds—which is the major predictor of reading fluency. He described how diffusion tensor imaging shows how specific nerve fibers pass through the corpus callosum and connect the two hemispheres. He explained that determining brain connections by seeing how water diffuses in and around those fibers is quite predictive of how well children or young adults learn to read. Properties of these specific nerve fibers are highly correlated with phonological awareness and therefore with reading capabilities. He and colleagues are now looking at research related to correlations between visual arts and math. Wandell made a point of encouraging educators to explore research questions that would be useful to them.

The afternoon session began with a keynote address by Jerome Kagan, Ph.D., Harvard University, who spoke on the topic “Why the Arts Matter: Six Good Reasons for Advocating the Importance of Arts in School.” Kagan outlined the need for children to develop personal agency and tools to acquire, store, and communicate knowledge. He said, “In sum, arts and music have an important role to play in American schools. I suspect that if American teachers devoted one hour each day to art or music, or even one hour two days a week, the proportion of youth who dropped out of high school might be reduced. Moreover, the child’s products would provide parents of failing children with an opportunity to praise children rather than criticize them for laziness.” (See chapter four for a full transcript.)

A panel of educators and arts advocates focused on the implications of the research for policy and practice. Moderated by Dick Deasy, former director of the Arts Education Partnership, the panel included Sarah Cunningham, Ph.D., director of arts education at the National Endowment for the Arts; Janet Eilber, director of arts education at the Dana Foundation; Mariale Hardiman, Ed.D., assistant dean and department chair at The Johns Hopkins



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University School of Education and a former principal; Mary Ann Mears, artist and founder of Arts Education in Maryland Schools; and Betty Morgan, Ph.D., superintendent of schools of Washington County, Maryland.

Deasy discussed the morning science presentations as well as a current movement in education, “action research,” through which teachers develop questions and pursue them within the contexts of their lives. The publication, *Critical Links*, edited by Deasy, was referenced throughout the summit as a guidepost for educators and arts organizations throughout the country.

In response to Deasy’s queries, Mears noted the work of James Catterall as having significant influence on her way of thinking about arts and education. Catterall’s analysis of data from NELS [National Educational Longitudinal Study] addresses the issue of equity by drawing a relationship between correlations, indicating that children from low socioeconomic backgrounds benefit significantly from the arts. “Equity is where the rubber meets the road in this work” Mears said.

Commenting on another Catterall study, Mears explained that the researchers gave two groups of children a prompt about Ancient Egypt. One group drew and then wrote in response to the prompt; the other group just wrote. The students who drew and then wrote had better organized and more detailed written responses. This was particularly true of students with limited English proficiency.

Morgan discussed how important research has been in helping her and others bolster arts in the community. Morgan noted that “the research has strengthened arts-education programs not only in Maryland, but everywhere.” She added that she was grateful to those engaged in research because it is critical for “those of us on the front lines ... to justify the arts in our programs and the expenditures arts incur.”

Cunningham discussed the importance of the research in terms of policy issues, saying that

research makes a difference to a funder when you have organizations “that are aware of what in detail is happening to the children.” She added that “this conversation with the scientific community demonstrates the richness of the moment. We have an opportunity as a federal agency to take this conversation to the press, the White House ... This conversation on the arts expands beyond artistic practice out into our moral effectiveness.”

Eilber spoke about how the arts can engage students by providing a different context for learning. She noted a study, “The Power of Art,” that looked at the elements of after-school programs that bring art to California youth. Eilber said that the most striking and revelatory point about the study was what these particular after-school programs in the arts offered that other programs, such as sports, did not. “It came down to one thing: responsibility for self expression,” she said.

Hardiman described her experience as a school principal: for 11 of her 12 years at one school, she witnessed consistent improvements in students’ reading and math scores. But she began to realize that “we were so focused on accountability and scores that there was something that was not as holistic as it should have been.” Hardiman developed the Brain-Targeted Teaching Model, which relies heavily on arts integration. “We started to look at how to get children to master key concepts and do repetition through arts-integration so that they didn’t think that they were repeating and repeating content, but manipulating it in different ways through the arts,” Hardiman explained.

The core of the summit was the roundtable discussion groups. Each roundtable included ten participants who represented the research community, classroom teachers, educational leaders, teacher educators, and policy makers. A facilitator helped shape the discussions and a recorder captured the dialogue. Discussions focused on what teachers want to know about the influence of arts integration on learning and development. They

were charged with generating research questions and determining the best methods for high-quality neuroeducation research. Discussions also focused on how potential findings could shape educational policy and practice. (See section six for roundtable discussion summaries.)

Among the more salient issues that emerged from the discussions were:

- Can the United States afford to abandon the training of creative ways of thinking and learning in the hope that these skills will come from some source other than specific training in the arts?
- What does an arts-integrated curriculum really look like? Teachers said that there needs to be a fully developed pedagogical model that could be applied to multiple subject areas. They asked how the application of such a model would change the teaching profession.
- Are we asking too much too early from the neurosciences? Educators and scientists argued that a conservative approach was needed. Neuroscientists need time to conduct studies and disseminate results.
- Can we study a school model where scientists and teachers collaborate to conduct research based on the needs of the classroom? Can we establish research schools where the teacher could be a co-principal investigator with the scientist?
- How can we bring parents into the conversation, and give them ways to use arts-integration strategies in the home? Families have a tremendous opportunity to support, enhance, and promote the arts at school, at home, and in the community.
- Is it possible to follow students who had arts integration in the early grades throughout high school? Is there a certain age or age group when exposure to music and other

art forms produces the best outcomes with regards to learning development?

- What is the role of the arts beyond improving academic performance? How can the arts support social and emotional learning?
- How can the arts help students with special needs?

Implications for Policy and Practice: A View from Science, Education, and the Arts

In this final chapter, the authors look to the future and assess how best the fields of neuroscience, education, and the arts can collaborate to bring change to education policy and practice.

In his essay, McKhann states that the relationship between neuroscience and education historically has been edgy. But this relationship is beginning to change, thanks to interdisciplinary approaches by several groups bringing educators and neuroscientists together, including the summit. From these discussions and the arts and cognition research, several concepts have emerged, including the need for educators to have a central place where they can ask questions. These questions, in turn, may stimulate further studies. McKhann points to research that suggests that there may be genetic factors that influence a child's reception to a particular type of art—music, dance, etc. He also emphasizes the work being done in enhancing attention mechanisms. He states that there is much yet to be learned.

In her piece on the education community, Hardiman says that the purpose of collaboration between the neuroscience and education communities is not to justify having arts in the schools. Educators who have already seen that the arts make students more creative learners do not need research explaining why. But neuroscience does add a level

of confirmation. Scientific evidence on the influence of arts-based learning will add new dimensions to educational practices and policies.

Understanding what makes students better learners, said Hardiman, may remain disconnected from substantive changes in educational policy. Educators will make incremental improvements in curricula, but real policy change has to do with repairing the disconnect between what children can do and our expectations of them, along with the disconnect between official accountability and the clamor for more creative skills. Hardiman offers readers a Neuro-Education Interdisciplinary Research Model that she and Susan Magsamen developed in order to begin answering these questions.

In her commentary, Eilber says that arts-education advocates have always believed intuitively that the arts are a highly effective vehicle for improved learning; scientists support this intuition through a growing body of serious research. The field is deeply involved in translating research findings into teaching practice. Eilber emphasizes that arts education offers a network of partners, working with school systems and building a reputation for alternative learning processes. A growing body of arts-based curricula is accountable to states' learning standards, supported by findings emerging from neuroscience, which can provide models for new brain-based pedagogy.

Summit Outcomes

Several key outcomes emerged from the summit. Educators are largely unaware of new scientific research; scientists typically do not conduct research with educators in mind as end users; and advocates are convinced of the efficacy of arts integration but need hard evidence to promote it. Communication among these constituencies is almost nonexistent; when information is shared it often is synthesized

into headlines or neuro-myths. Ongoing discussion and collaboration has yet to evolve.

And yet, the sense was that education, the arts, and brain sciences might give impetus to the new field of neuroeducation, bringing together diverse thinking, invigorating pedagogical practice, and promoting research with relevant applications.

The cautionary message was that one should not confuse the artifacts of brain research (e.g., imaging) with its larger, not-yet developed potential, which is to create a guide for improving teaching strategies based on research about how children think and learn.

The benefits of harnessing these domains are to:

- create new processes to integrate basic and cognitive-science knowledge through translational strategies
- promote flexibility and innovation in instruction design
- explore more precisely the nature of creativity and apply it to encourage the transfer of knowledge and skills
- enhance cognitive development at all ages
- support advocacy with new evidence
- address particular learning differences.

What did we learn at this summit?

Four points clearly emerged from the panels and the roundtable discussions:

1. Educators and researchers must communicate and collaborate.

Meaningful collaboration will require educators and brain researchers to understand one another's language, processes, and outcomes.

Educators want cognitive and brain scientists to work with them to create and conduct research that sheds light on how children learn in forms that can be applied to the classroom.



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Researchers need to understand how teachers teach and which measurements are most useful. Teachers need to understand what research can deliver and how to frame the demands they make on it. Arts educators and proponents of arts-based instruction need to codify the meaning of arts learning so that teachers in other disciplines can understand how it benefits students, making them more prepared and willing to integrate the arts. Universities that train new teachers and provide professional development for experienced ones need to promote research and integrate findings into revised curricula.

Underlying all these conditions is a need for broader communication to engage parents, families, school boards, community-service providers, legislators, and other constituents who determine educational policy.

2. Translation of research must occur in different forms.

At a basic level, translation should involve researchers working hand-in-hand with educators in the classroom to understand and address specific needs and questions. As methodologies emerge and are tested, effective strategies should be published in

the form of tool kits for dissemination to teachers. For broader availability and consumption, tool kits and other resources should be posted in central Web-based repositories for interested professionals to consult. Educators should provide this information to parents as much as possible in order to allow parents to be strong educational partners with schools on behalf of their children.

3. Lab schools should be cultivated as authentic settings for research and the development of integrated pedagogical models.

Schools can become laboratories that cultivate relationships between the research and educational communities, with researchers and teachers working side by side in classroom settings. The schools may be organized within a university that trains teachers or may operate with less formal arrangements between higher-education institutions and local schools.

However they are organized, lab schools should bring together scientists and educators in a joint effort to design, perform, and test applications of translational research in the classroom. The involvement of teachers from many different disciplines is critical, as is a focus on topics and problems rather than specific subjects. Of note, The International Mind, Brain, and Education Society (IMBES) has begun to develop standards for the creation of lab schools. This process should continue to build integrated research in academic settings at all age levels.

4. Arts learning must be better understood before we can successfully integrate the arts across the curriculum.

Teachers of music, theater, dance, creative writing, and the fine arts—with the support of researchers—must define what they do in terms of improving students' cognitive development. Educators experienced in successful arts integration should contribute to the development of tool kits.

It is not enough to say that the arts enrich the school experience; individual art forms should be analyzed separately with a view toward the particular outcomes they best support. Which outcomes are measurable, and how are they measured? Do the arts demonstrably improve scores on standardized achievement tests? Can we keep separate the effects of the arts-learning process from the evaluation of the finished product? How much time is required for arts learning and arts integration to show an effect, and does this effect last?

In the end, the summit clearly illustrated the need to bring educators, researchers, and key policymakers together to talk to one another about the importance of the arts in education. The

summit brought to light key issues, from simple terminology disconnects to larger policy and implementation challenges. It also demonstrated that when you bring passionate, diverse thinkers together to solve essential learning and social problems, they do so with insight and thoughtfulness, resulting in new directions and potentially transformative outcomes.

Throughout this report there are examples of many new directions and ideas for future research that need further elaboration. Our hope is that the summit, its participants, and ongoing conversation about critical concepts will continue to be revisited, leading to new knowledge, practices, and success for our children.